$ 5.00
DIV. 79
CALIB. LAB.

INSTRUCTION MANUAL

FOR

MODEL 152-S-478

VARIPHASE GENERATOR

WAVETEK
SAN DIEGO

9045 BALBOA AVENUE, SAN DIEGO, CALIFORNIA

DIV. 79
CALIB. LAB.

INSTRUCTION MANUAL

FOR

MODEL 152-S-478

VARIPHASE GENERATOR

THIS DOCUMENT CONTAINS INFORMATION PROPRIETARY TO WAVETEK. THE INFORMATION IN THIS DOCUMENT IS NOT TO BE USED OR DUPLICATED IN ANY MANNER WITHOUT THE PRIOR APPROVAL IN WRITING OF WAVETEK.

7/75

CONTENTS

SECTION 1 INTRODUCTION

1.1 MODEL 152-S-478 1-1
1.2 INTERFACE 1-1
1.3 OPTIONS 1-1
1.4 ACCESSORIES 1-1
1.5 PHYSICAL DESCRIPTION 1-1
1.6 SPECIFICATIONS 1-2
1.6.1 Versatility 1-2
1.6.2 Accuracy 1-2
1.6.3 Purity 1-3
1.6.4 Environmental 1-3
1.6.5 Mechanical 1-3

SECTION 2 INSTALLATION AND INTERFACE

2.1 MECHANICAL INSTALLATION 2-1
2.2 ELECTRICAL INSTALLATION 2-1
2.2.1 Power Connection 2-1
2.2.2 Signal Connections 2-1
2.2.3 Control Connections 2-1

SECTION 3 OPERATION

3.1 INITIAL CHECKOUT 3-1
3.2 CONTROLS, INDICATORS AND PROGRAMMING 3-1
3.2.1 Power 3-1
3.2.2 Indicators 3-1
3.2.3 Programming 3-1
3.2.4 Unit Selected Address 3-2
3.2.5 Function (Waveform) 3-2
3.2.6 Frequency and Multiplier 3-2
3.2.7 Amplitude and Multiplier 3-2
3.2.8 Signal Reference Offset 3-3
3.2.9 Phase Angle 3-3
3.2.10 Execute 3-3
3.3 OPERATING PROCEDURE 3-3
3.3.1 Operating as a Basic Waveform Generator 3-3
3.3.2 Operating as a DC Voltage Source 3-3
3.3.3 Operating as a Variphase Generator 3-3

SECTION 4 CIRCUIT DESCRIPTION

SECTION 5 CALIBRATION

5.1 FACTORY REPAIR 5-1
5.2 REQUIRED TEST EQUIPMENT 5-1
5.3 CALIBRATION 5-1

SECTION 1
INTRODUCTION

1.1 MODEL 152-S-478

The Model 152-S-478 is a two channel source of selectable carrier waveforms with variable phase relationship. Both channels provide suppressed carrier modulation (SCM) where the modulation signal is from an external low frequency source (1 Hz to 3 kHz). The carriers of both channels have the same frequency, and the phase relationship between the two carriers may be set at any desired angle.

The generator is digitally controlled locally with front panel keyboard pushbuttons, and remotely with a selection of 21 ASCII (7-level) "typing" characters (with appropriate external interface). The effect of each control is digitally displayed on the front panel with red LED (light emitting diode) indicators. Numeric readout of frequency, offset and amplitude is in 3-digit scientific notation. Phase angle is displayed in 4 digits.

Sine, cosine, triangle, square, variphase sine and variphase square carrier waveforms of frequencies from 1 Hz to 100 kHz plus dc and amplitudes from 10 mV peak to 9.99V peak can be generated.

Waveform center reference levels can be offset positive or negative from 10 mV to 9.99V and selected waveform phase, or polarity, can be inverted (180 degrees).

Along with the two low impedance ($<1\Omega$, 100 mA maximum drive) rear panel outputs (CH 1 and CH 2), which are the controlled waveform signal outputs, the generator delivers a square wave of the selected frequency for a synchronizing pulse output (SYNC OUT).

A TTL input is received at the rear panel for external synchronization operation (SYNC IN).

An analog modulation signal must be applied to rear panel (AUX 1 and AUX 2) for SCM of CH 1 and CH 2, respectively.

Remote programming is accepted at a rear panel connector (EXT PROGRAM).

All programming (except phase angle) for one channel is stored in buffer registers while the other channel is being programmed. When the programming is completed, an EXECUTE command will transfer data from all the buffer registers to working registers, thus activating the digital to analog converters. In the case of phase angle programming, the phase angle program is accepted only for the last channel accessed.

Up to nine generators can be connected in parallel with one another as a multiple unit group. Each generator is internally configured with its own address, or unit select code, from 1 to 9. For example, an installation may have one master display and keyboard panel, which is used to address and command the slave generators. The status of the addressed generator would be displayed.

1.2 INTERFACE

The generator accepts TTL ground true 7-bit ASCII "typing" characters serially; the 7 bits of each character are accepted in parallel. A clock line in parallel with the data bits is used to clock in the data characters. Computer control is accepted as is keyboard control from another generator in multiple unit groups. With computer control, the generator keyboard control panel can be locked out, or disabled, to prevent control competition.

1.3 OPTIONS

Several interface options are available. They include input isolation and proposed IEC compatible and RS232 serial data converters.

1.4 ACCESSORIES

Accessories for the generators include interfaces for several mini-computers.

1.5 PHYSICAL DESCRIPTION

The mechanical characteristics of the Model 152 are given in paragraph 1.6.5. The standard model comes equipped with a 10 foot, 3 wire detachable power cord and rack

mount adapters. Interface cabling requires Molex brand connectors (see paragraph 2.2.3); one is furnished.

1.6 SPECIFICATIONS

Specifications apply for control settings from 1.00 to 9.99.

1.6.1 Versatility

Waveforms
Sine ∿, cosine ∿, triangle ∿, square ⎍, variphase sine, variphase square, and dc selectable. All waveforms except triangle and variphase sine may be inverted by changing the polarity of the peak amplitude programming.

Frequency Range
1 Hz to 100 k Hz in 5 ranges with 3-digit resolution.

10^0	1 Hz to 9.99 Hz
10^1	10 Hz to 99.9 Hz
10^2	100 Hz to 999 Hz
10^3	1 kHz to 9.99 kHz
10^4	10 kHz to 99.9 kHz

Modulation Input (AUX 1 and AUX 2)
For a general 152 output, a −5.0 Vdc ±10 mVdc must be applied.
For an in-system SCM output, a 5.0 Vp ±10 mV sine wave between 1 Hz and 3 k Hz must be applied.
Input impedance greater than 10 kΩ.

Main Outputs
The in-system 152-S-478 outputs are as follows:
±9.99 Vp SCM with a 500 Hz to 12 kHz carrier. Modulation is externally generated and applied through AUX 1 and AUX 2 inputs for channels 1 and 2, respectively.

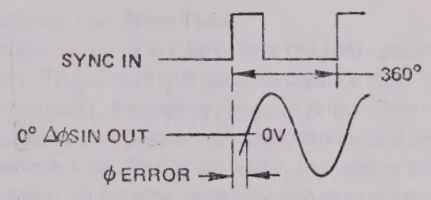
152 Outputs – General
DC voltage ±10 mV dc to ±9.99 Vdc. Sine, cosine, triangle, square, variphase sine and variphase square, 10 mV peak to 9.99V peak in 3 ranges (10^0, 10^{-1}, 10^{-2}). 100 mA peak maximum output current. Output impedance less than 1Ω. Outputs obtainable only with −5 Vdc ±10 mV on AUX 1 and AUX 2 inputs for channels 1 and 2, respectively.

Variable Phase
One channel of variphase (sine or square) may be varied with respect to another variphase channel (or sync input) from 0° to 360° with 0.1° resolution.

DC Offset
All waveforms may be offset 9.99V above or below ground level with 3-digit resolution and selectable polarity. Signal level plus offset voltage must not exceed ±9.99V peak.

Sync Output
The sync output is a TTL compatible square wave capable of sinking 13 mA for a fan-out of 8. This output is intended as a triggering source only, and has an unspecified phase relationship with the + SIN or 0° ΔϕSIN outputs.

Sync Input
The externally generated sync input must be a TTL compatible square wave capable of sinking 20 mA. The sync input circuit will provide a "frequency phase lock" between 152 and the sync input, providing the sync input frequency is within 1% of the 152 frequency. Synchronization operation will accurately align the leading edge of the sync input and the rising zero-crossing of the 0° ΔϕSIN carriers.
The input is terminated by 220Ω to +5V and 330Ω to ground. Open circuit voltage is +3V.



1.6.2 Accuracy

Horizontal Precision (Frequency Accuracy)
±(1% of program +0.1% of range) for 1 Hz to 10 kHz.
±(2% of program +0.1% of range) for 10 kHz to 100 kHz.

Vertical Precision
Defined with −5 Vdc ±10 mV on AUX 1 and AUX 2 inputs.
Square and Variphase Square Waveforms:
±(1% of program +0.1% of range) for 1 Hz to 10 kHz.
±(3% of program +0.1% of range) for 10 kHz to 100 kHz.
Sine, Cosine and Variphase Waveforms:
±(4% of program +0.1% of range) for 1 Hz to 10 kHz.
±(6% of program +0.1% of range) for 10 kHz to 100 kHz.
Triangle Waveform:
±(3% of program +0.1% of range) for 1 Hz to 10 kHz.

NOTE

Vertical precision stated is for 10^0 amplitude multiplier. For 10^{-1} and 10^{-2}, add 2% per decade attenuation ±5 mV dc offset.

DC Offset
±(1% of program +0.1% of range).

Sine Wave Frequency Response
Amplitude Change With Frequency:
±0.3 dB to 10 kHz.
±0.5 dB to 100 kHz.

Phase Angle (Channel to Channel)
Channel 2 With Respect to Channel 1:
±0.3° to 1 kHz.
±1.0° to 10 kHz.
±4.0° to 100 kHz.

Phase Angle (Channel to SYNC IN)
Variphase Sine:
±1.0° for 500 Hz to 1 kHz.
±2.5° for 500 Hz to 12 kHz.
Variphase Square:
±1.5° for 500 Hz to 1 kHz.
±3.0° for 500 Hz to 12 kHz.

Amplitude Stability
Short Term: ±0.10% for 10 minutes with ±1°C change.

Phase Angle Stability
<.5° phase angle jitter for 500 Hz to 12 kHz.

Frequency Stability
Short Term: ±0.05% for 10 minutes.
Long Term: ±0.25% for 24 hours.

1.6.3 Purity

Sine Wave Distortion
Defined with −5 Vdc ±10 mV on AUX 1 and AUX 2 inputs.
Sine, Cosine, and ΔϕSIN Outputs:
Less than 1% total harmonic distortion for 1 Hz to 10 kHz.
Less than 2% total harmonic distortion for 10 kHz to 100 kHz.

Triangle Linearity
Greater than 99% to 10 kHz.

Square Wave Rise and Fall Time
Less than 3 μs for 20V p-p (6.7 V/μs)

Total Aberrations
Less than 5% of program value ±10 mV

Suppressed-Carrier Spectrum
Carrier frequency component in any SCM output > 30 dB down from either sideband.

1.6.4 Environmental

Specifications apply for 25°C ±5°C. For operation from 0°C to +50°C, derate all specifications by a factor of 2. Unit may be stored from −40°C to +75°C without damage.

1.6.5 Mechanical

May be used on the bench or in a 19-inch rack. Rack adapter hardware and program mating connectors included.

Dimensions
17¼ in./43.8 cm wide, 7 in./17.8 cm high, 23½ in./59.7 cm deep.

Weight
43 lb/19.5 kg net, 52 lb/23.6 kg shipping

Power
90V to 110V, 105V to 125V, 180V to 220V, or 210V to 250V; 50 Hz to 400 Hz. Less than 150 watts.

Programming Transition Time
Unit accepts bytes at a 1 MHz rate (10 kHz rate for optical isolation). The output will become stable within 100 μs unless frequency, frequency range or phase angle is changed. For frequency and frequency range, the output will be stable within 1 ms. For phase angle, the output will be stable within 10 ms after receiving the next program prefix (e.g. A for amplitude).

Isolation
Signal ground is isolated from program ground in the 152-S-478 via option 001.

Logic Level Requirements

State	Requirements
Low (Logic "1")	0V to 0.4V sinking 25 mA maximum
High (Logic "0")	2.4V or open

NOTE

1. *Open input is 3.0V.*
2. *Input is terminated by 220Ω to +5V and 330Ω to ground.*
3. *Recommended driver: SN 7438.*

SECTION 2
INSTALLATION AND INTERFACE

2.1 MECHANICAL INSTALLATION

After unpacking the instrument, visually inspect all external parts for possible damage to connectors, surface areas, etc. If damage is discovered, file a claim with the carrier who transported the unit. The shipping container and packing material should be saved in case reshipment is required.

The standard generator is a bench-top instrument with a collapsible tilt-bail to elevate its front end for convenient viewing.

The generator has rack mount adapters on the sides. For convenience, we recommend that users purchase a pair of chassis slides when rack mounting.

2.2 ELECTRICAL INSTALLATION

2.2.1 Power Connection

NOTE

Unless otherwise specified at the time of purchase, this instrument was shipped from the factory with the power transformer connected for operation on a 105 - 125 Vac line supply and with a 1½ amp slow-blow fuse.

Conversion for 90 to 110V, 180 to 220V, or 210 to 250V operation requires resetting two switches on the rear panel. Set the two switches and select the fuse for the ac line voltage according to the following table.

AC Line Voltage	Switch A	Switch B	Fuse (SB)
90 - 110	115	LO	1½ amp
105 - 125	115	HI	1½ amp
180 - 220	230	LO	¾ amp
210 - 250	230	HI	¾ amp

Connect the ac line cord to the mating connector at the rear of the unit.

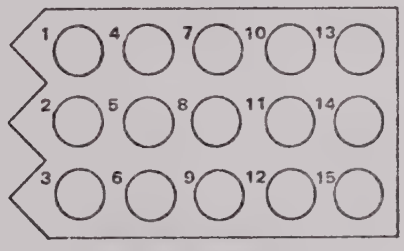
2.2.2 Signal Connections

Use 50Ω shielded cables equipped with female BNC connectors to distribute CH 1 OUT, CH 2 OUT, SYNC OUT, SYNC IN and AUX IN signals when connecting this instrument to associated equipment.

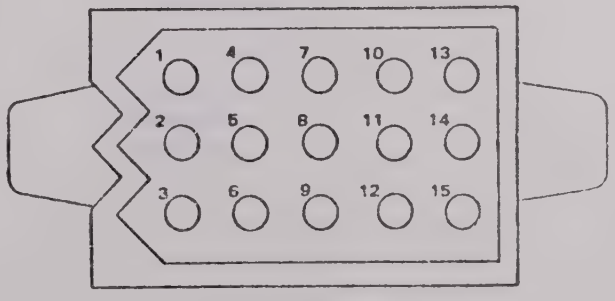
2.2.3 Control Connections

The remote (ASCII DATA IN/OUT) rear panel connection, harness wire colors, pin connections and signal names are given in Tables 2-1 and 2-2.

The remote connector is a Molex 03-09-1151 which mates with a Molex 03-09-2151 connector housing with up to 15 Molex 02-09-2118 pin contacts. Pin contacts are prepared using a Molex Model A6973 Crimping Tool to connect No. 18 or No. 22 wire (strip back 1/10 to 1/8 inch).



MOLEX 03-09-1151



MOLEX 03-09-2151

Figure 2-1. Connectors (Socket/Pin Sides)

Table 2-1. ASCII DATA IN/OUT AND HARNESS CONNECTORS

Pin	Connector: ASCII Data In/Out (Rear Panel) Wire Color	Signal	Keyboard Harness Wire Color	Signal	Display Harness Wire Color	Signal
1	1	PCOM				
2	2					
3	3	KINH	2	KINH		
4			1	+5V	7	+5V
5	5					
6	6	BUSY				
7	7	COM	91	COM	0	COM
8	8	XD2	8	KD2	1	DCLK
9	9	XD4	5	KD4		
10	90	XD3	3	KD3	2	DD0
11	91	XD1	7	KD1	4	DD2
12	92	XD5	4	KD5		
13	93	XD0	90	KD0	6	DSYNC
14	94	XD6	6	KD6	3	DD3
15	95	XCLK	9	KCLK	5	DD1

Code	Color	Code	Color
0	Black	8	Gray
1	Brown	9	White
2	Red	90	White with black tracer
3	Orange	91	White with brown tracer
4	Yellow	92	White with red tracer
5	Green	93	White with orange tracer
6	Blue	94	White with yellow tracer
7	Violet	95	White with green tracer

PCOM: Input Program Common (connected to signal common unless isolation config)
BUSY: Not Ready for New Data
KINH: Keyboard Inhibit
COM: Signal Common
X: External
D: Data
0 - 6: Bits 0 thru 6
CLK: Clock
K: Keyboard
D: Display

True = Low
False = High
TTL Voltage Level

Table 2-2. KEY, ASCII, HEXADECIMAL, AND BINARY CODES FOR PROGRAMMING FUNCTIONS

Control and Data Names	Model 152 Key	ASCII Character and TTY Keyboard	Hexa-Decimal Code	Binary (and ASCII Bus) Bit 7 XD6	Bit 6 XD5	Bit 5 XD4	Bit 4 XD3	Bit 3 XD2	Bit 2 XD1	Bit 1 XD0
Range (X 10 mult)*		(Space)	20	0	1	0	0	0	0	0
Invert phase/offset	CHS	–	2D	0	1	0	1	1	0	1
0	0	0	30	0	1	1	0	0	0	0
1	1	1	31	0	1	1	0	0	0	1
2	2	2	32	0	1	1	0	0	1	0
3	3	3	33	0	1	1	0	0	1	1
4	4	4	34	0	1	1	0	1	0	0
5	5	5	35	0	1	1	0	1	0	1
6	6	6	36	0	1	1	0	1	1	0
7	7	7	37	0	1	1	0	1	1	1
8	8	8	38	0	1	1	1	0	0	0
9	9	9	39	0	1	1	1	0	0	1
Peak amplitude	AMPL	A	41	1	0	0	0	0	0	1
Output channel	CHNL	B	42	1	0	0	0	0	1	0
Function (waveform)	FUNC	C	43	1	0	0	0	0	1	1
Reference offset	OFST	D	44	1	0	0	0	1	0	0
Range (X 10 mult)*	MULT	E	45	1	0	0	0	1	0	1
Frequency	FREQ	F	46	1	0	0	0	1	1	0
Unit select address	UNIT	G	47	1	0	0	0	1	1	1
Phase angle	ANGL	H	48	1	0	0	1	0	0	0
Execute	EXEC	I	49	1	0	0	1	0	0	1

1 = True = Low
0 = False = High
TTL Voltage Level

*See the second entry of this control name.

2.2.4 Isolation and Keyboard Inhibit

The Model 152 may be controlled by a remote controller whose system ground reference is separated from the instrument signal common. With this isolation, the input program common remains separated from the instrument signal common. Most options include isolation; option 152-001 is the isolation-only option. The optical isolators used provide up to 1500 volts of signal isolation. (Optical isolation reduces character programming rate to 10 kHz.)

Frame ground is connected to the instrument chassis and the third (green wire) pin on the power plug.

To disable the Model 152 keyboard, the keyboard inhibit line must be connected to the signal common. With most options, a programmable relay for disabling is provided to ensure isolation. The keyboard inhibit line nominal open circuit voltage is 3 volts with respect to signal common.

SECTION 3
OPERATION

3.1 INITIAL CHECKOUT

Model 152-S-478 is operated only as outlined in paragraph 1.6.1, Main Outputs. Out-of-system checkout and operation can be accomplished by injecting −5 Vdc ±10 mV into the AUX 1 and AUX 2 BNCs. Some specifications are necessarily derated from the standard 152.

To ensure that the generator is operating properly, make the power and interface connections (Section 2). Operate the generator, function-by-function, as described in the following paragraphs.

3.2 CONTROLS, INDICATORS AND PROGRAMMING

The generator has a 20 pushbutton front panel keyboard to provide the same control as the 20 remotely programmed ASCII character bytes.

The 20 generator controls and their various code conversions are listed in table 2-2. The generator front panel controls and indicators are shown in figure 3-1.

3.2.1 Power

Power is turned on and off with the PWR pushbutton. When the power is turned on, the generator is automatically addressed and is ready to accept commands. If a different generator is to be addressed, use the UNIT control (refer to paragraph 3.2.4). Also, when the power comes on, the generator is in standby state until properly programmed. While in this state, the display may show improper indications.

3.2.2 Indicators

The indicators turn on to show the various functions, values, sign, and address programmed; the numerals displayed are significant as frequency, amplitude, phase angle or offset, but only one category at any one time. For frequency, amplitude and offset, scientific notation is displayed. (Scientific-notation is ().()() (), where the first three () are significant digits and the last () is a power of ten, a multiplier.) For phase angle, a 3-digit whole number and a 1-digit decimal is displayed.

The digits are displayed in the order of entry, shifting right-to-left as shown in table 3-1. (Only the last entered set of significant digits and the last entered digit for the power of ten are stored for any given address, such as function, amplitude, etc. Any previously entered digits are shifted out of memory.)

Table 3-1. EXAMPLE OF PROGRAMMING

Sequence	Wavetek Keyboard	Remote ASCII	Lighted Display
1	UNIT	G	–
2	1	1	UNIT SELECTED
3	FREQ	F	FREQ
4	5	5	0.05
5	7	7	0.57
6	9	9	5.79
7	MULT	E	–
8	3	3	3 (Power of Ten)
9	CHNL	B	–
10	1	1	CHNL 1
11	FUNC	C	–
12	0	0	SIN
13	AMPL	A	AMPL
14	5	5	0.05
15	0	0	0.50
16	0	0	5.00
17	MULT	E	–
18	0	0	0 (Power of Ten)
19	EXEC	I	–

Note: The output signal will not appear until "EXEC" is commanded.

3.2.3 Programming

Programming is mostly a matter of prefixing, by sequence, the numerical values and numeric codes with their intended use. For example, programming a 5.79 kHz, 5.00V peak sine wave on Channel 1 of Unit No. 1 is given in table 3-1.

A graphical representation of programming the 152 is shown in figure 3-1, where each programmed character allows further access into a branching network or allows an exit from one branch and an entrance to another. The example in table 3-1 applied to figure 3-1 shows how programming G1, or pressing the UNIT and the 1 keyboard keys, gains access to the "Model 152" branch. Programming F, or pressing the FREQ key, gives access to the frequency branch of the Model 152. After the values of frequency are programmed, another branch is selected, etc., until the 152 is programmed as desired. The EXEC key, or programmed I, transfers the programmed, or keyed, data into D-to-A converters for an actual generator output.

NOTE

Any character may be separated by spaces, periods or other characters not defined here. Spaces may be inserted between alpha control characters and numeric fields; however, a space will move from a value field to the exponent field (where scientific notation is used) after at least one numeric digit has been received. (See paragraphs 3.2.6 and 3.2.7)

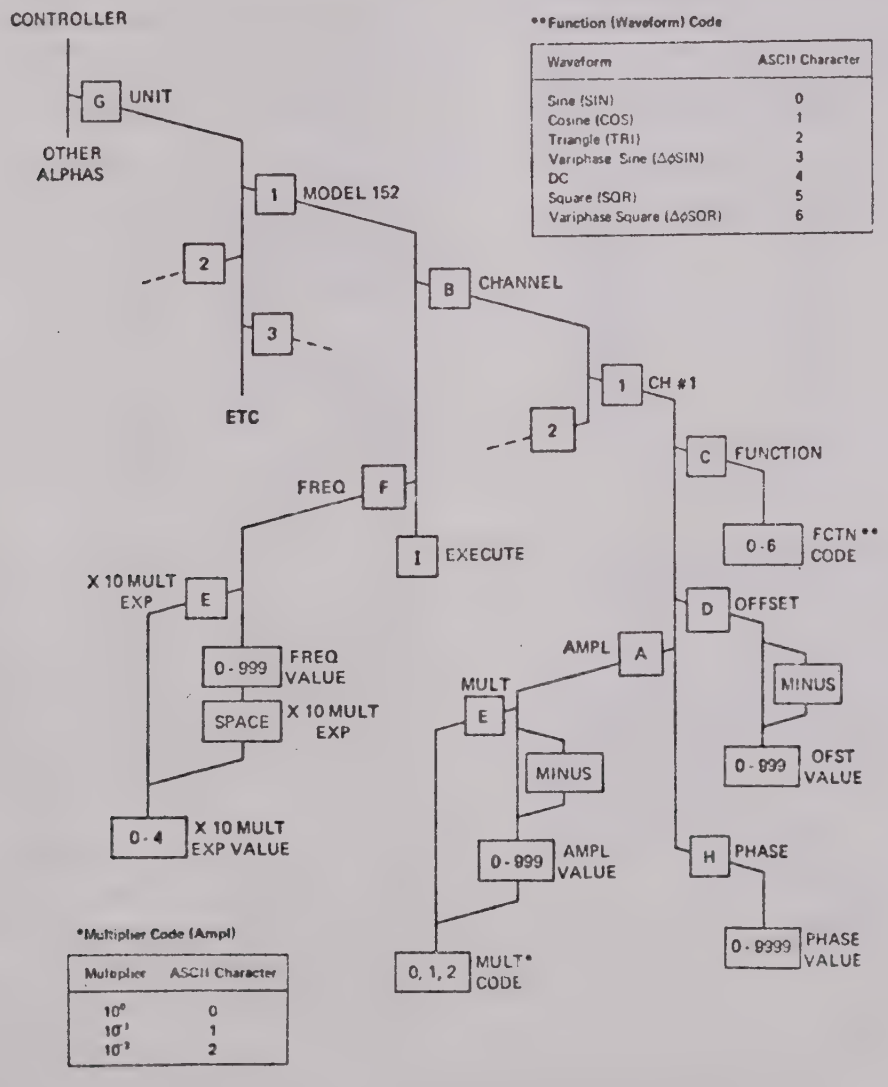


Figure 3-1. Programming Branch Network

The 152 generates a busy signal while calculating sine and cosine values. The channel number cannot be changed while the busy signal is asserted.

If a phase angle value is followed by an execute, all registers except phase will be updated immediately and phase angles will be updated 1 to 2 ms later when the sine calculator provides the values.

The generators are designed to accept a scientific notation input format. System programmers using FORTRAN will find that the result of the format statement

20 FORMAT (1 HF, 1PE13.3)

will control the frequency without additional processing.

The following paragraphs describe the program elements and give their ASCII codes. The Model 152 front panel keys correspond one-for-one with the ASCII codes; if there is any doubt as to correspondence, refer to table 3-2.

Table 3-2. KEYBOARD TO ASCII CONVERSION TABLE

Keyboard	ASCII	Keyboard	ASCII
AMPL	A	MULT	(Space) or E
UNIT	G	ANGL	H
OFST	D	EXEC	I
CHNL	B	0 thru 9	0 thru 9
FUNC	C	CHS	– (Minus)
FREQ	F		

3.2.4 Unit Selected Address

After the unit prefix (G), program one digit to select the unit. The unit addressed in a multiple unit group responds to subsequent commands; other units do not. Generators are given the address of 1 at the factory unless specified otherwise at the time of purchase. Address changes are easily made in the field. Subsequent instructions will be accepted by the last unit addressed.

3.2.5 Function (Waveform)

After the function prefix (C), program one digit to select the desired waveform or DC voltage. Waveforms or DC voltage can be inverted during amplitude selection.

Waveform	ASCII Character
Sine (SIN)	0
Cosine (COS)	1
Triangle (TRI)	2
Variphase sine (ΔϕSIN)	3
DC	4
Square (SQR)	5
Variphase square (ΔϕSQR)	6

3.2.6 Frequency and Multiplier

After the frequency prefix (F), program a 3-digit number (1.00 to 9.99) for the three most significant digits; after the multiplier prefix (E or space), program the power of 10 (0 thru 5).

3.2.7 Amplitude and Multiplier

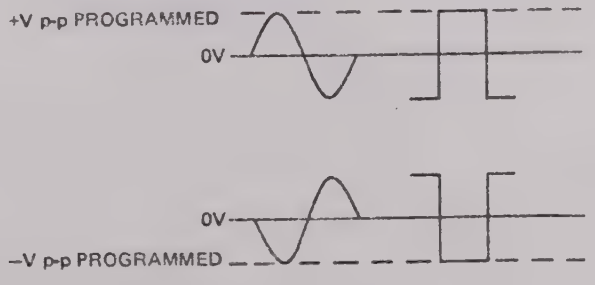
After the amplitude prefix (A), program (–) if waveform inversion is desired (triangle and variphase sin cannot be inverted); then, program a 3-digit number (0.00 to 9.99) for the three most significant digits. After the multiplier prefix (E or space), program the power of 10 (0, 1 or 2). Powers 1 and 2 are automatically accepted as –1 and –2. Amplitude programmed is peak voltage.

Function	Inversion
SIN	Yes
COS	Yes
TRI	No
ΔϕSIN	No
DC	Yes
SQR	Yes
ΔϕSQR	Yes

NOTE

DC offset plus waveform peak value may not exceed 100 mA peak load current.

All waveforms have a center reference level. Notice the inversion caused by programming –V peak. Normal waveforms start in the positive direction regardless of their offset. Inverted waveforms start in the negative direction regardless of their offset.



3.2.8 Signal Reference Offset

After the offset prefix (D), program (–) if negative offset is desired; then, program a 3-digit number (0.00 to 9.99) for the offset.

Offset control allows the generator output reference level to be offset, or displaced positive or negative to 10V. All waveforms have a center reference level from which the offset is made.

NOTE

DC offset plus waveform peak value may not exceed 10V peak into an open circuit or 5V peak into 50Ω.

3.2.9 Phase Angle

After the phase angle prefix (H) program a 4-digit number (000.0 to 359.9) to change the phase angle of the channel programmed.

3.2.10 Execute

Programming execute (I) enables the output by transferring data from the program buffer to the working buffer.

NOTE

All the programs required for all the available channels can be stacked before executing the transfer.

3.3 OPERATING PROCEDURE

No preparation for operation is required beyond the completion of the initial installation checks. Allow the generator and associated equipment to warm up for specified generator accuracies. Refer to the control descriptions given in paragraph 3.2 for actual keyboard or remote commands.

NOTE

Use the same length of RG58 for both Channel 1 and Channel 2 cables.

3.3.1 Operating as a Basic Waveform Generator

Simply program the desired waveform, frequency, amplitude and offset for each channel.

3.3.2 Operating as a DC Voltage Source

DC voltage output is ±10V, 100 mA obtained by using the DC function.

1. Select DC function.
2. Program the desired voltage and polarity.

3.3.3 Operating as a Variphase Generator

An output is phase shifted with respect to the sync output, sync input from another source or with respect to the other output channel.

NOTE

The accuracy of phase angle is defined between two variphase-sine or square selected channels only.

1. Connect external sync if desired.
2. Program the desired waveform, frequency, amplitude and offset. (If external sync is used, sync and program frequencies must be within 1%. The waveform for the phase shifted channel must be either variphase sine or variphase square.)
3. Program the desired phase angle for the channel with the variphase waveform.

SECTION 4
CIRCUIT DESCRIPTION

4.1 LOGIC NOTATION AND TERMINOLOGY

To avoid confusion in determining logic states, please read and understand the following ground rules used in this manual.

1. On the schematics, all signals are true-when-high unless their mnemonics are overscored; the overscore indicates true-when-low.

2. Pulse and clock refer to transient change of state, whereas status refers to a logic state which requires new input to change.

4.2 BASIC OPERATION

The overall operation can be easily followed in figure 4-1. All digital programmed ASCII data, via the keyboard, the remote ASCII connector or optional interface card, is decoded into hexadecimal data on the logic interface board. The data is then distributed throughout the logic control circuitry to program all of the holding registers which control the operation of the generator. The generator frequency can be phase locked to an external source through the SYNC IN BNC connector. The SYNC OUT provides TTL compatible waveforms used for triggering purposes. The logic interface board also includes the data multiplexing circuitry for the display data. The display data is multiplexed into the display bus for display panel illumination. The routing of the correct data to the correct display is determined by a clock pulse and sync pulse on this bus.

The function generator generates symmetrical triangle and square waveforms simultaneously. Since this is a voltage controlled generator, the integrating current, frequency, is easily controlled with a D/A. The frequency range register selects the range integrating capacitor.

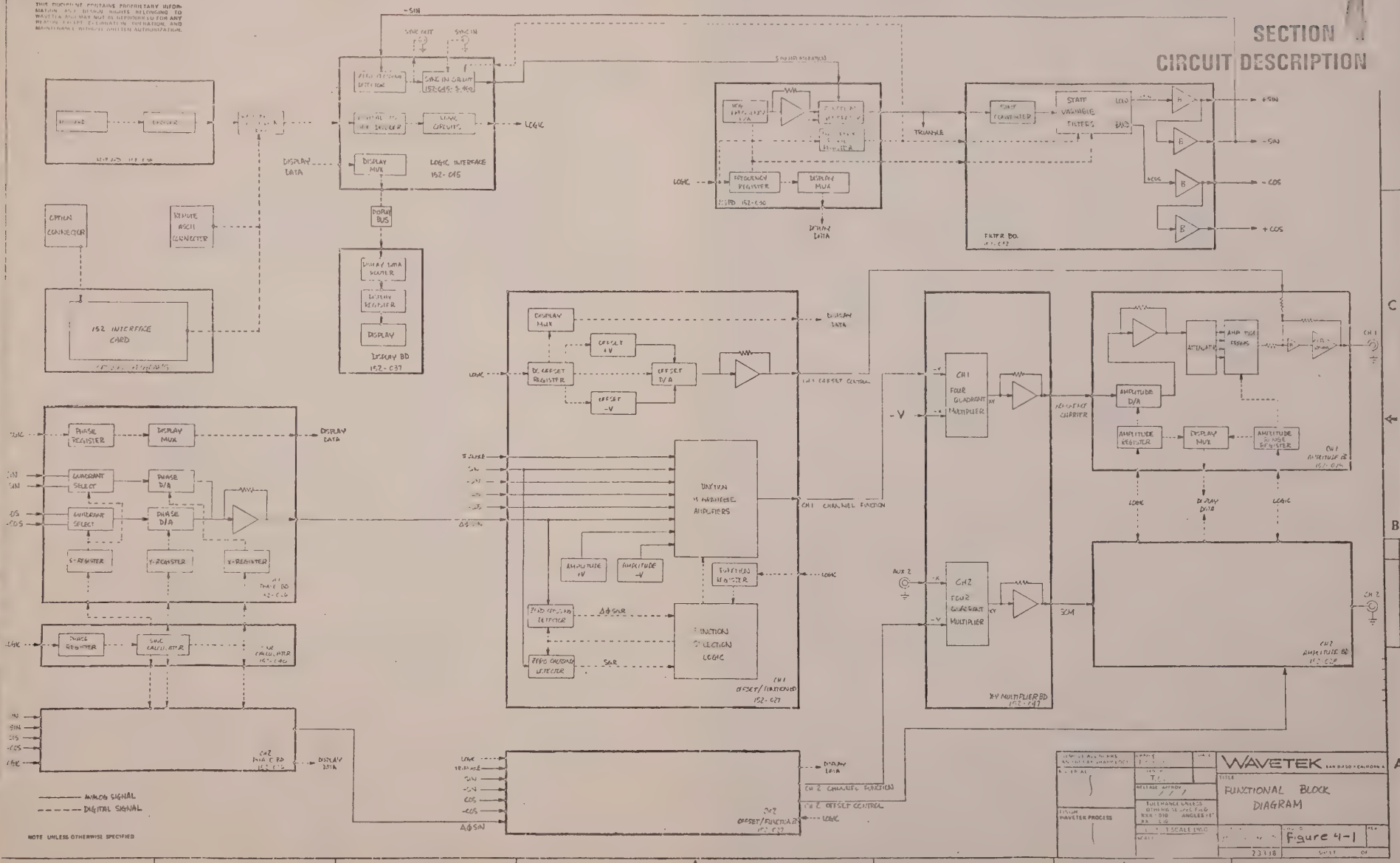
The triangle is fed to the filter board where it is shaped into a sine wave by diode nonlinearity. The state variable filter creates a sine/cosine relationship by using a frequency tracking bandpass and low pass filter. The filter outputs are buffered and inverted to create the quadrature components of the sinusoidal waveform..

To control the phase angle of the variphase sine wave, a fundamental trigonometric identity is used, $\sin(\omega t + \theta) = \cos\theta \sin\omega t + \sin\theta \cos\omega t$, where $\sin(\omega t + \theta)$ is an expression of relative signal amplitude of between 1 and -1 at time t when starting at angle θ. $\sin\omega t$ and $\cos\omega t$ are the sine and cosine functions created by the state-variable filter where $\omega = 2\pi$ frequency. $\sin\theta$ and $\cos\theta$ are computed at the sine calculator board from the program phase angle θ. These computed values are transferred to the phase board where they are multiplied by $\sin\omega t$ and $\cos\omega t$ with the phase D/As. The phase D/A outputs are summed to create the $\sin(\omega t + \theta)$ variphase sine wave and then transferred to the offset/function board.

Zero crossing detectors are used to create a variphase square wave and square wave from the variphase sine wave and sine wave, respectively. The square and variphase square wave, through the function select logic, control the ±V amplitude inputs of the programmable amplifiers to produce the same waveform at the programmable amplifiers output. The function selection logic selects one of six waveforms on the output of the programmable amplifiers.

This output is fed into one input (−Y) of the X-Y multiplier and the external AUX input is fed into the other input (−X). The output from the X-Y multiplier is directly proportional to the product of these two inputs. In the in-system 152-S-478, this waveform will be a Suppressed Carrier Modulated (SCM) signal. This SCM signal is attenuated via the amplitude D/A and summing amplifier. The signal is then decade-attenuated with a programmable amplifier before being fed into an output amplifier. The offset voltage from the offset D/A (function/offset board) is also injected at this summing node. The output amplifier consists of a fast differential input amplifier and a high current gain amplifier to provide $<1\Omega$ output impedance and 100 mA maximum current capabilities.

THIS DRAWING CONTAINS PROPRIETARY INFORMATION WHICH REMAINS THE PROPERTY OF WAVETEK AND MAY NOT BE REPRODUCED OR FOR ANY PURPOSE EXCEPT OPERATION, INSTALLATION, AND MAINTENANCE WITHOUT WRITTEN AUTHORIZATION.



WAVETEK SAN DIEGO, CALIFORNIA

TITLE: FUNCTIONAL BLOCK DIAGRAM

Figure 4-1

23118

SECTION 5
CALIBRATION

5.1 FACTORY REPAIR

Wavetek maintains a factory repair department for those customers not possessing the necessary personnel or test equipment to maintain the instrument. If an instrument is returned to the factory for calibration or repair, a detailed description of the specific problem should be attached to minimize turnaround time.

5.2 REQUIRED TEST EQUIPMENT

DVM
Oscilloscope, Dual Channel With Comparator and Differential Inputs
Counter
Distortion Analyzer
Spectrum Analyzer, HP3580A or equivalent

5.3 CALIBRATION

After referring to the following preliminary data, perform calibration, as necessary, per table 5-1. If performing partial calibration, check previous settings and adjustments for applicability.

1. Refer to appropriate board assembly drawings for test point and adjustment locations.

2. TPs (Test Points) and adjustments are prefixed as follows:

A1	Power Supply
A2	VCG Board
A3	Filter Board
A4	Channel 1 Phase Board
A5	Channel 2 Phase Board
A6	Channel 1 Offset/Function Board
A7	Channel 2 Offset/Function Board
A8	X-Y Multiplier Board
A9	Channel 1 Amplitude Board
A10	Channel 2 Amplitude Board
A11	Logic Interface/Sync Circuit

3. Before connecting the unit to an ac source, check the ac line circuit to make sure the 115/230 and HI/LO switches are set at the correct position (see paragraph 2.2.1).

4. Start the calibration by executing the following program:

Frequency	9.99E2
Channel	1
Amplitude	9.99E0
Offset	0.00
Function	0
Angle	045.0
Execute	
Channel	2
Amplitude	9.99E0
Offset	0.00
Function	0
Angle	0
Execute	

5. Allow the unit to warm-up at least 30 minutes prior to final calibration.

6. Dotted lines in table 5-1 indicate data from previous step remains applicable.

Table 5-1. CALIBRATION CHART

Seq	Check	Tester	Calibration Points	Program	Control	Desired Results	Remarks
1	Power supply regulation	DVM	Across A2C2 (neg side to DVM com)	See initial conditions	A1R28	+15 Vdc ±10 mV	Put VCG bd on extender.
2			Across A2C4 (pos side to DVM com)		NA	−15V reading same as +15V reading ±5 mV	
3			Across A1C8 (6000 μF) (neg terminal to DVM com)		A1R2	+5.020 Vdc ±5 mV	
4	Square wave time sym	Scope	A2TP6		A2R55	Horiz (time) sym error <0.1%	
5				Freq 1.00E3	A2R66		Repeat steps 4 and 5, as necessary, for correct adjustment.
6	Freq tracking	Counter	CH 1 BNC	Freq 9.99E3	A2R10	9.99 kHz	Input −5.00 Vdc to AUX 1 and AUX 2.
7				Freq 1.00E3	A2R~~31~~ 32	1.00 kHz	Repeat steps 6 and 7, as necessary, for correct adjustment.
8	Freq linearity			Freq 9.99E0	A2R10	9.99 Hz	
9				Freq 9.99E1		99.9 Hz	
10				Freq 9.99E2		999 Hz	
11				Freq 9.99E3		9.99 kHz	Leave A2R10 at best freq agreement on these ranges.
12				Freq 9.99E4	A2C41	99.5 kHz	
13				Freq 1.00E4 thru 9.99E4 in 2.25 increments		Best linearity	

Table 5-1. CALIBRATION CHART (Continued)

Seq	Check	Tester	Calibration Points	Program	Control	Desired Results	Remarks
Replace VCG board and put filter board on extender. Ensure that no external sync cable is connected to scope.							
14	Distortion	Scope (differential input)	A3 1V SINE TP	Freq 9.99E2	A3R22 A3R23	±0.5V peaks ±2 mV	
15		Distortion analyzer			A3R2 A3R22	Lowest distortion with smooth residue (minimum 2nd harmonic)	Distortion typically <0.25%.
16		Scope (differential input)			A3R23	1.00V p-p ±4 mV	
17	Filter balance		A3C37 (sin)	Freq 9.00E3	A3R60	No dc offset	Connect scope probe to front side of capacitor.
18				Freq 1.09E3	A3R114		
19				Freq 1.90E3	A3R113		
20			A3C44 (cos)	Freq 1.00E3	A3R52		
21				Freq 1.09E3	A3R64		
22				Freq 1.90E3	A3R55		
23				Freq 9.99E3		<10 mV offset	If >10 mV, repeat steps 17 - 23.
24			A3C37 (sin)				
25	Filter buffers		A3 +SINE TP	Freq 8.00E2	A3R30 A3R110	±5.000 Vp ±5 mV	Connect scope probe to test point.
26			A3 –SINE TP		A3R112		
27			A3 ±COS TP		A3R29 A3R106		
28			A3 +COS TP		A3R108		
29	Filters freq E4 balance		A3 +SINE TP A3 –COS TP	Freq 5.00E4	A3C41	+sin and –cos amplitudes = ±20 mV	Ensure scope probe is properly compensated for HF measurements.

Table 5-1. CALIBRATION CHART (Continued)

Seq	Check	Tester	Calibration Points	Program	Control	Desired Results	Remarks
30	Filters freq E4 balance	Scope (differential input)	A3 +SINE TP A3 –COS TP	Freq 5.00E4	A3C48 A3R25	+sin and –cos amplitudes ±5.000V ±20 mV peak	*NOTE: A3C48 balances the filters to the program freq. A3R25 acts only as an absolute amplitude control and is useful in balancing out the freq E4 range.* Repeat steps 29 and 30, as necessary, for proper calibration.
31				Freq 9.99E4		±5.00V ±100 mV peak +sin and –cos	If tolerance is met, skip step 32.
32					A3R25		Repeat steps 30, 31, and 32 until +sin and –cos amplitudes track within ±100 mV of ±5V from freq 1.00E4 thru 9.99E4.
33	CH 1 phase		A4TP1	Freq 8.00E2 ∠ –45°	A4R1 A4R2	±5.000 Vp ±5 mV	Replace filter board and put channel 1 phase board on extender.
34	CH 2 phase		A5TP1		A5R1 A5R2		Replace channel 1 phase board and put channel 2 phase board on extender.
35	CH 1 offset	DVM	A6TP1	CH 1 Func 4 Ampl 0.00E0 Ofst 9.99	A6R3	–9.99 Vdc	Replace channel 2 phase board and put channel 1 ofst/func board on extender.
36				Ofst –9.99	A6R4	+9.99 Vdc	Program – key.
37	CH 1 amplitude		A8TP5	Func 5 Freq 0.50E0 Ampl 9.99E0 Ofst 0.00	A6R2 A6R1	+9.99V +peak –9.99V –peak	

Table 5-1. CALIBRATION CHART (Continued)

Seq	Check	Tester	Calibration Points	Program	Control	Desired Results	Remarks
38	CH 2 offset	DVM	A7TP1	CH 2 Func 4 Ampl 0.00E0 Ofst 9.99	A7R3	–9.99 Vdc	Replace channel 1 ofst/func board and put channel 2 ofst/ func board on extender.
39				Ofst –9.99	A7R4	+9.99 Vdc	
40	CH 2 amplitude		A8TP3	Func 5 Ampl 9.99E0 Ofst 0.00	A7R2 A7R1	+9.99V +peak –9.99V –peak	
41	CH 1 X-Y modulated carrier	Scope (trig from 152 SYNC OUT)	A8TP15	CH 1 Freq 9.60E3 Ampl 9.99E0 Ofst 0.00 Func 2	A8R14 A8R10	Linear 20 mV triangle	Input ±5.00 Vp 800 Hz sine wave (no dc ofst) at AUX 1. Replace channel 2 ofst/func board and put X-Y mult board on extender clip jumper between A8TP16 and A8TP12. While varying A8R14 for approx 20 mV triangle on either side of null, set A8R10 for minimum warp.
42					A8R14	Null	
43		Scope (trig from AUX 1)			A8R15	Minimum amplitude signal	Move jumper from A8TP12 to A8 TP11.
44				Func 5	A8R13 A8R21	±9.99V peaks	Remove jumper. Input –5.00 Vdc at AUX 1.
45	CH 2 X-Y modulated carrier	Scope (trig from 152 SYNC OUT)	A8TP14	CH 2 Freq 9.60E3 Ampl 9.99E0 Ofst 0.00 Func 2	A8R32 A8R36	Linear 20 mV triangle	Input ±5.00 Vp 800 Hz sine wave (no dc ofst) at AUX 2. Clip jumper between A8TP16 and A8TP10. Adjust A8R36 for approx 20 mV triangle on either side of null and adjust A8R32 for minimum warp.
46					A8R36	Null	
47		Scope (trig from AUX 2			A8R37	Minimum amplitude signal	Move jumper from A8TP10 to A8TP9.

Table 5-1. CALIBRATION CHART (Continued)

Seq	Check	Tester	Calibration Points	Program	Control	Desired Results	Remarks
48				Func 5	A8R35 A8R37	±9.99V peaks	Remove jumper. Input –5.00 Vdc at AUX 2.
49	CH 1 output ampl	DVM	CH 1 BNC	CH 1 Freq 0.50E0 Ampl 0.00E3 Ofst 0.00 Func 4	A9R59	0.00 Vdc ±5 mV	Replace X-Y mult board and put channel 1 ampl board on extender.
50				Ampl 0.00E2	A9R55		
51				Ampl 0.00E1	A9R69		
52				Ampl 0.00E0	A9R65		
53		Scope (differential input)		Freq 8.00E2 Ampl 9.99E0 Func 5	A9R78	±9.99 Vp square wave	Set A9R78 so that the ± peak amplitudes give a magnitude of ±9.99 Vp.
54	CH 1 output offset	DVM		Ampl 0.00E0 Ofst 9.99	A9R81	9.99 Vdc ±5 mV	
55				Ofst –9.99		–9.99 Vdc ±10 mV	A9R81 may be reset for best results between ±ofst.
56	CH 2 output ampl	DVM	CH 2 BNC	CH 2 Ampl 0.00E3 Ofst 0.00 Func 4	A10R59	0.00 Vdc ±5 mV	Replace channel 1 ampl board and put channel 2 ampl board on extender.
57				Ampl 0.00E2	A10R55		
58				Ampl 0.00E1	A10R69		
59				Ampl 0.00E0	A10R65		
60		Scope (differential input)		Freq 8.00E2 Ampl 9.99E0 Func 5	A10R78	±9.99 Vp square wave	Set A10R78 so that the ± peak amplitudes give a magnitude of ±9.99 Vp.
61	CH 2 output offset	DVM		Ampl 0.00E0 Ofst 9.99 Func 4	A10R81	+9.99 Vdc ±5 mV	
62				Ofst –9.99		–9.99 Vdc ±10 mV	A10R81 may be reset for best results between ±ofst.

Table 5-1. CALIBRATION CHART (Continued)

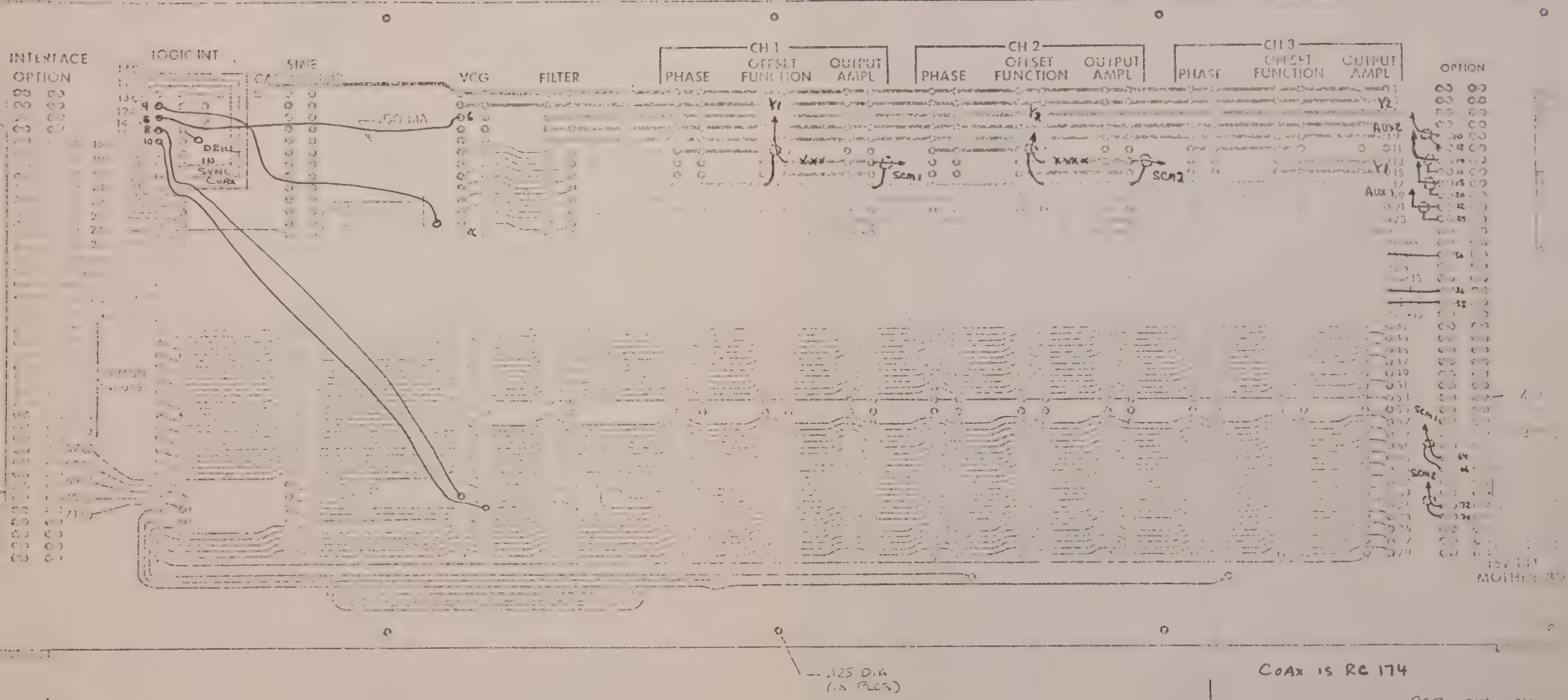
Seq	Check	Tester	Calibration Points	Program	Control	Desired Results	Remarks
	Replace channel 2 amplifier board. Put logic interface board on extender. Connect TTL sync signal ±1% of 152 frequency to 152 sync in BNC and to channel 1 of scope. Connect channel 1 BNC of 152 to channel 2 of scope. Display two cycles, observing lock. Using time delay multiplier, expand and display the second sync in signal leading edge at X 100 magnification. Set A11R20 for coincidence of 152 reference sine positive going zero crossing point with the sync in leading edge.						
63	Sync in cal	Dual trace scope (alt or chop display, int trig, channel 1 only, pos slope)	CH 1 BNC Sync in BNC	CH 1 Freq 8.00E2 Ampl 9.99E0 Ofst 0 Func 3 Angl 000.0	A11R20	Coincidence of leading edge of sync in signal on channel 1 of scope with 0° zero crossing of 152 reference carrier sine output on channel 2 of scope.	
64				Freq 9.99E3	A11R19		Reset sync in freq to ±1% of 152 and proceed in manner of step 63. Repeat steps 63 and 64, as necessary, for proper calibration.
	Replace all boards and front panel. Allow ½ hour stabilization. Connect 800 Hz sync TTL signal to sync in BNC and a 20 Hz ±9.99V sine from modulation source to AUX 2 BNC. Connect channel 2 BNC to spectrum analyzer.						
65	System check at Lockheed installation	Spectrum analyzer HP3580A or equivalent setup: 800 Hz F_0 1 Hz bw 5 Hz/div Input — +20 dBm	CH 2	Freq 8.00E2 CH 1 Ampl 9.99E0 Ofst 0.00 Angle 000.0 Func 0 Execute CH 2 Ampl 9.99E0 Ofst 0.00 Angle 000.0 Func 0 Execute		Display center freq in center of analyzer as suppressed carrier at approx −40 dBm and sidebands at center frequency ±20 Hz at approx −7 dBm	Adjust the dc offset of the external AUX input. It need only be adjusted once at this setting.
66				CH 2 Ampl −9.99E0			
67				CH 2 Ampl 9.99E0 Func 1			

Table 5-1. CALIBRATION CHART (Continued)

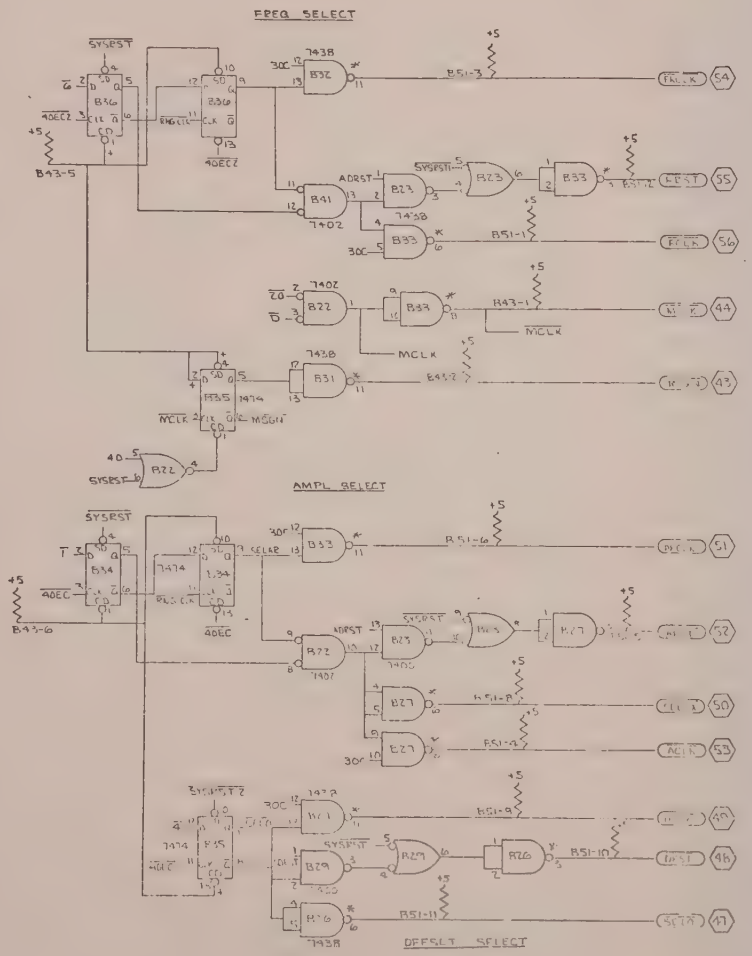
Seq	Check	Tester	Calibration Points	Program	Control	Desired Results	Remarks
68				CH 2 Ampl −9.99E0			
69				CH 2 Ampl 9.99E0 Angle 000.0 Func 3			
70				Angle 090.0			
71				Angle 180.0			
72				Angle 270.0			
73				Angle XXX.X			XXX.X = any desired angle between the 4 quadrants.

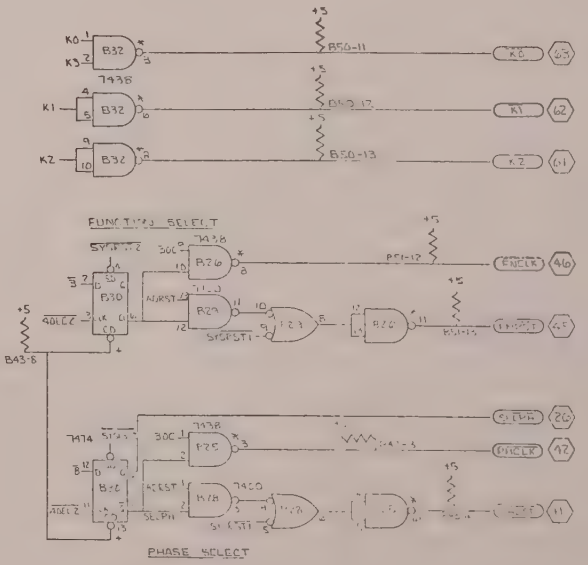
Assuming poor carrier suppression in general in steps 65 thru 68, the dc offset of the external 20 Hz modulation source may be adjusted for best suppression. If uneven results are obtained at the four quadrants (steps 69 - 72), one or more may have some offset. The respective control may be adjusted for improved results.

Step	Control
69	A3R110
70	A3R112
71	A3R106
72	A3R108


INTERFACE OPTION
LOGIC INT
SINE
VCG
FILTER
CH 1
PHASE
OFFSET FUNCTION
OUTPUT AMPL
CH 2
PHASE
OFFSET FUNCTION
OUTPUT AMPL
CH 3
PHASE
OFFSET FUNCTION
OUTPUT AMPL
OPTION
50 DIA
DRILL IN SYNC CURR
XXX
SCM1
SCM2
Y1
Y2
AUX2
AUX1
.125 DIA (4 PLCS)
COAX IS RG 174
XXX .010
XX .03
PCB, DRILLED
MOTHER BD
1452-054-5478
MOTHER Bd
MODIFICATIONS

THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION AND DESIGN RIGHTS BELONGING TO WAVTEK AND MAY NOT BE REPRODUCED FOR ANY REASON EXCEPT CALIBRATION, OPERATION, AND MAINTENANCE WITHOUT WRITTEN AUTHORIZATION



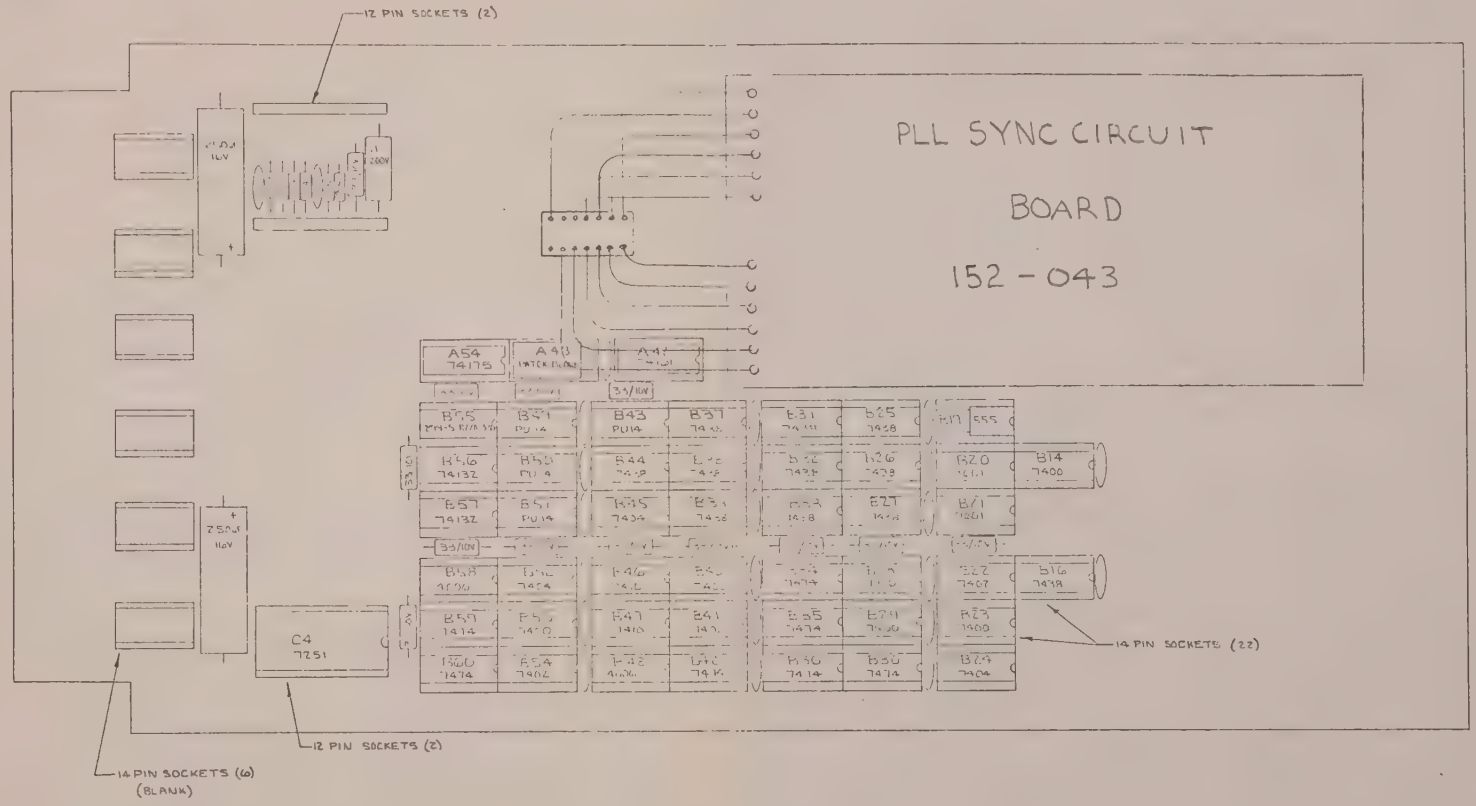


NOTE UNLESS OTHERWISE SPECIFIED

WAVETEK

152-SYNTH

THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION AND DESIGN RIGHTS BELONGING TO WAVETEK AND IS NOT TO BE REPRODUCED FOR ANY REASON EXCEPT CALIBRATION, OPERATION AND MAINTENANCE WITHOUT WRITTEN AUTHORIZATION



2. USE WIRE WRAP NO. 152-122.
1. ALL CAPS ARE .1uF @ 10V.

UNLESS OTHERWISE SPECIFIED

WAVETEK

ASSEMBLY
LOGIC INTERFACE
S-478

S-3476

ITEM NO.	REF DESIG	DESCRIPTION	MFGR PART NO.	MFGR	WAVETEK PART/STOCK NO.	QTY	STATION NO.	PREP NO.
1		P. C. BOARD DRILLED	152-122	WVTK		1		
2								
3		CAP, CER DISC .1µF, 10V	UK10-104	CRL		21		
4		CAP, CER DISC .01, 20V	CK-103	CRL		1		
5		CAP, CER DISC 33pf	DD330	CRL		1		
6		CAP, TANT 33/10V	150D336X9010B2	SPRG		13		
7		CAP .1, 200V		SPRG		1		
8		CAP, ELECTROLYTIC 250µF, 16V	22-437-250-15T	SPRG		2		
9								
10		RES, METF 1/8W, 1%, 10K	RN55D	CRNG		2		
11		RES, METF 1/8W, 1%, 49.9K	RN55D	CRNG		2		
12								
13		DIODE	FD6666	FCHLD		2		
14								
15		IC, SOCKET 12 PIN	CSA-2300-12	SAE		4		
16		IC, SOCKET 14 PIN	CSA-2200-14BC	SAE		50		
17		IC, SOCKET 16 PIN	CSA-2200-16BC	SAE		3		
18								
19		IC, PATCH BLOCK				1		
20		IC, TIMER	NE555	SGNTCS		1		
21								
22		IC, 899-5-R220/230	899-5-R220/330	BCKMN		5		
23		IC, 9601	9601	FCHLD		2		
24		IC, 4006	4006	MOTOR		2		
25								
26		IC, QUAD 2-INPUT NAND GATE	N7400	SGNTCS		5		
27		IC, QUAD 2-INPUT NOR GATE	N7402	SGNTCS		4		
28		IC, HEX INVERTER	N7404	SGNTCS		3		
29		IC, TRIPLE 3-INPUT NAND GATE	N7410	SGNTCS		2		
30		IC, QUAD 2-INPUT BUFFER	N7438	TI		11		
31		IC, DUAL D FLIP-FLOP	N7474	SGNTCS		7		
32		IC, 2-INPUT SCHMITT TRIGGER	N74132	TI		2		
33		IC, 16 TO 1 DATA SELECTOR	9311/74154	FCHLD		1		
34		PATCH BLOCK		AGET		1		
35		IC, 74175	74175	TI		1		
36		IC, 74161	74161	TI		1		

WAVETEK®
PARTS LIST

TITLE ASSEMBLY LOGIC INTERFACE
MODEL 152

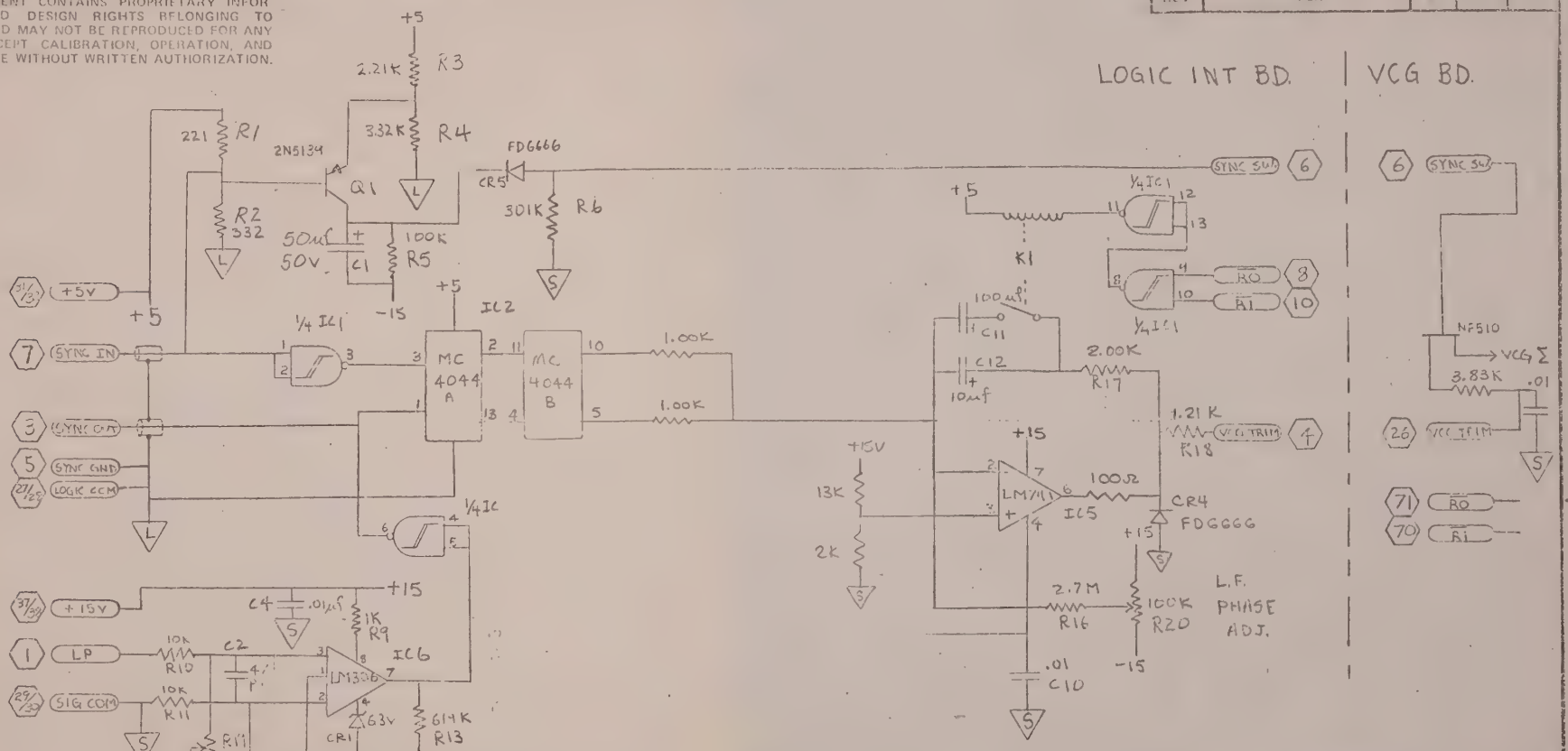
DRAWN BY Bill Adkins
APPROVAL

NO. 152-045
SH 2 OF 2

REV B

THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION AND DESIGN RIGHTS BELONGING TO WAVETEK AND MAY NOT BE REPRODUCED FOR ANY REASON EXCEPT CALIBRATION, OPERATION, AND MAINTENANCE WITHOUT WRITTEN AUTHORIZATION.

REV	ECN	BY	DATE	APP

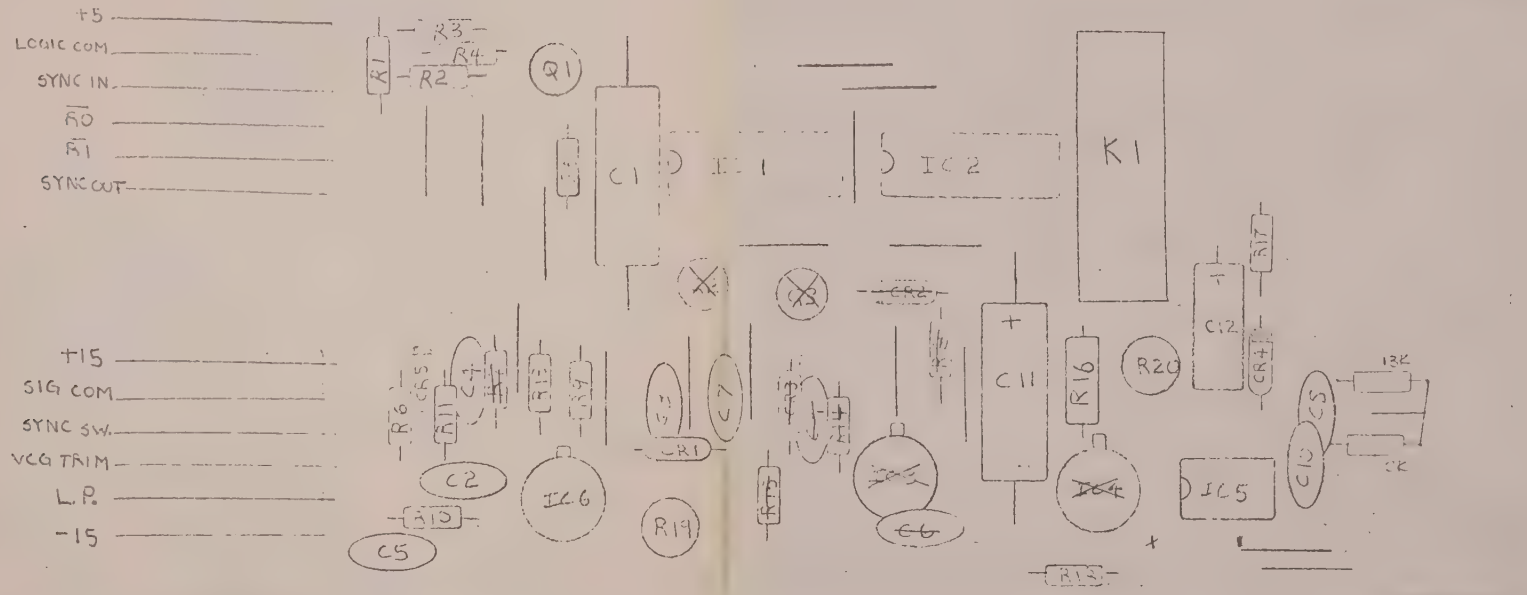


NOTE: UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN PMG	DATE	WAVETEK SAN DIEGO • CALIFORNIA
MATERIAL	PROJ ENGR		TITLE 152 PHASE LOCK LOOP SCHMATIC DIAGRAM S478
	RELEASE APPROV		
FINISH WAVETEK PROCESS	TOLERANCE UNLESS OTHERWISE SPECIFIED .XXX ±.010 ANGLES ±1° .XX ±.030		
	DO NOT SCALE DWG	MODEL NO. 152-S478	DWG NO. 152-243 REV
	SCALE	CODE IDENT. 23338	SHEET OF

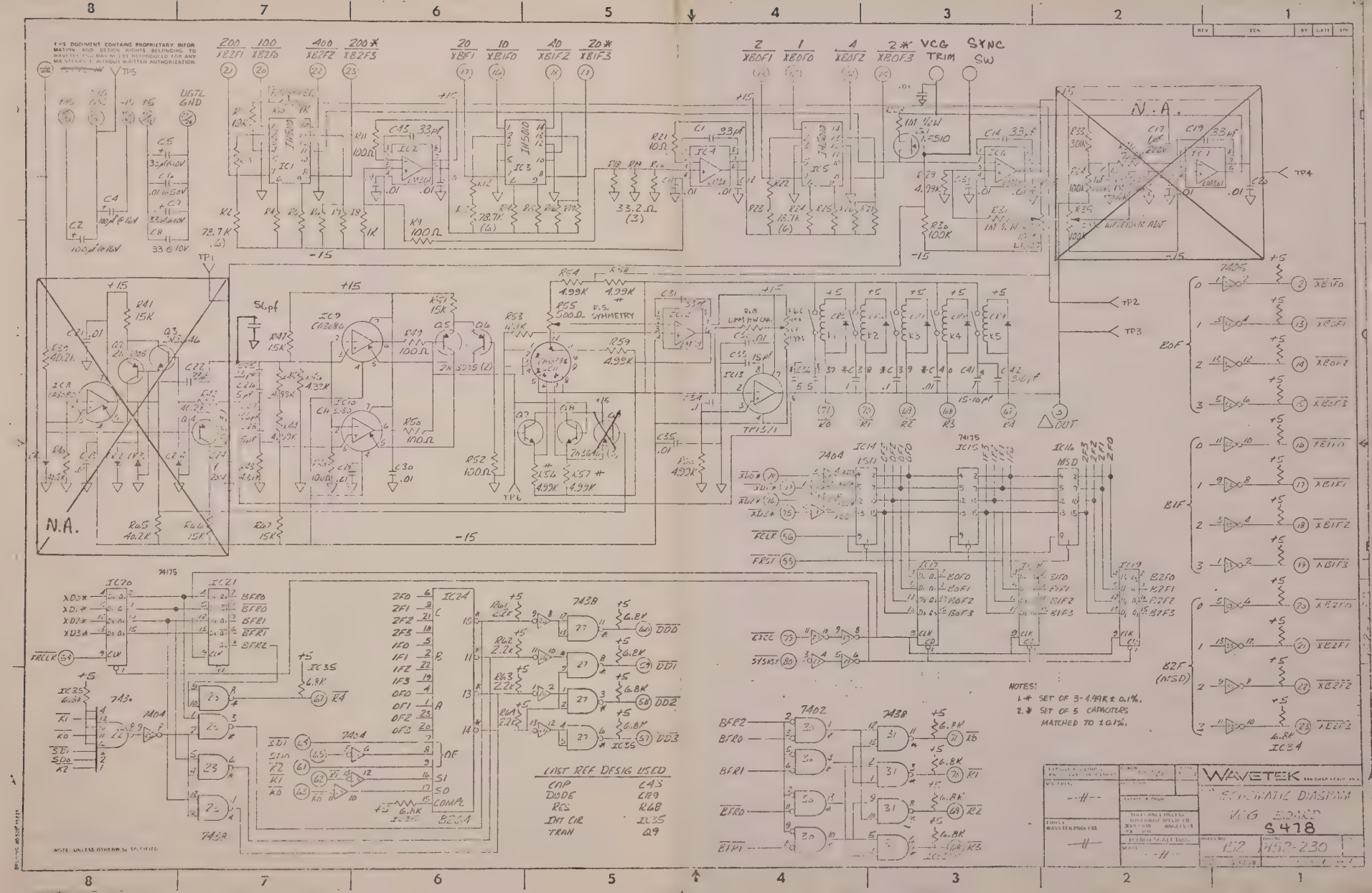
THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION AND DESIGN RIGHTS BELONGING TO WAVETEK AND MAY NOT BE REPRODUCED FOR ANY REASON EXCEPT CALIBRATION OPERATION AND MAINTENANCE WITHOUT WRITTEN AUTHORIZATION

REV	ECN	BY	DATE	APP

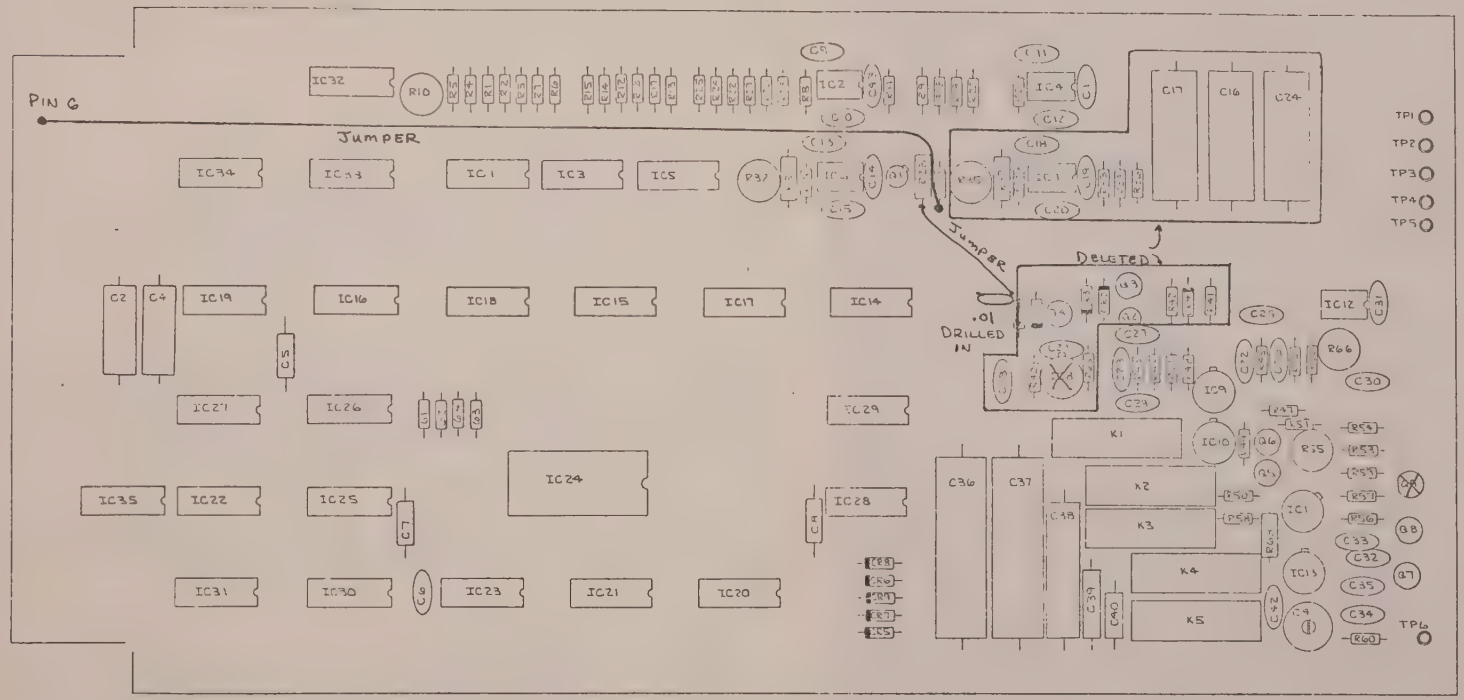


REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN R.B.G.	DATE 5-13-77	WAVETEK SAN DIEGO • CALIFORNIA
MATERIAL	PROJ ENGR T. O.		TITLE ASSEMBLY PLL SYNC CIRCUIT S-478
	RELEASE APPROV		
FINISH WAVETEK PROCESS	TOLERANCE UNLESS OTHERWISE SPECIFIED .XXX ±.010 ANGLES ±1° XX ±.030		
	DO NOT SCALE DWG	MODEL NO 152-S478	DWG NO B152-043 REV A
	SCALE	CODE IDENT 23338	SHEET 1 OF 3

NOTE: UNLESS OTHERWISE SPECIFIED


THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION AND DESIGN RIGHTS BELONGING TO WAVETEK AND MAY NOT BE REPRODUCED FOR ANY PURPOSE WITHOUT WRITTEN AUTHORIZATION.
200 XB2F1
100 XB2F0
400 XB2F2
200* XB2F3
20 XB1F1
10 XB1F0
40 XB1F2
20* XB1F3
2 XB0F1
1 XB0F0
4 XB0F2
2* XB0F3
VCG TRIM
SYNC SW
N.A.
+15
-15
DIGL GND
TP1
TP2
TP3
TP4
TP5
TP6
IC1
IC2
IC3
IC4
IC5
IC6
IC7
IC8
IC9
IC10
IC11
IC12
IC13
IC14
IC15
IC16
IC17
IC18
IC19
IC20
IC21
IC22
IC23
IC24
IC35
7404
7438
74175
7402
B0F
B1F
B2F (MSD)
NOTES:
1.# SET OF 3-4.99K ± 0.1%.
2.* SET OF 5 CAPACITORS MATCHED TO ± 0.1%.
LIST REF DESIG USED
CAP C43
DIODE CR9
RES R48
INT CIR IC35
TRAN Q9
WAVETEK
SCHEMATIC DIAGRAM
VCG BOARD
$478
152
152-230

THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION AND DESIGN RIGHTS BELONGING TO WAVETEK AND MAY NOT BE REPRODUCED, IN PART OR IN WHOLE, WITHOUT THE PRIOR WRITTEN CONSENT OF WAVETEK. ANY REPRODUCTION, USE OR OPERATION NOT EXPRESSLY AUTHORIZED BY WAVETEK IS PROHIBITED.



NOTE UNLESS OTHERWISE SPECIFIED

WAVETEK SAN DIEGO, CALIFORNIA

ASSEMBLY
VCG BOARD
S 478

15-2-5478 D152-030

SHEET 1 OF 4

8 7 6 5 4 3 2 1

D C B A

ITEM NO.	REF DESIG	DESCRIPTION	MFGR PART NO.	MFGR	WAVETEK PART/STOCK NO.	QTY	STATION NO.	PREP NO.
1		P. C. BOARD	152-130	WVTK		1		
2								
3								
4	R9, 11, 48, 50, 52, 49	RES, METF, 1/8W, 1%, 100Ω	RN55D	CRNG		6		
5	R18,19,20	RES, METF, 1/8W, 1%, 33.2Ω	RN55D	CRNG		3		
6	R21	RES, METF, 1/8W, 1%, 10Ω	RN55D	CRNG		1		
7	R8	RES, METF, 1/8W, 1%, 1K	RN55D	CRNG		1		
8	R61-R64	RES, METF, 1/8W, 1%, 2.21K	RN55D	CRNG		4		
9	R43,46	RES, METF, 1/8W, 1%, 4.32K	RN55D	CRNG		2		
10	R29,44,45, 54, 59,60	RES, METF, 1/8W, 1%, 4.99K	RN55D	CRNG		6		
11	R53	RES, METF, 1/8W, 1%, 12.1K	RN55D	CRNG		1		
12	R30,41,47,51, R67	RES, METF, 1/8W, 1%, 15K	RN55D	CRNG		5		
13	R39,40,42,65	RES, METF, 1/8W, 1%, 40.2K	RN55D	CRNG		4		
14	R36	RES, METF, 1/8W, 1%, 76.8K	RN55D	CRNG		1		
15	R1-R7, R12-R17, R22-R27	RES, METF, 1/8W, 1%, 78.7K	RN55D	CRNG		19		
16	R34	RES, METF, 1/8W, 1%, 100K	RN55D	CRNG		1		
17	R38	RES, METF, 1/8W, 1%, 150K	RN55D	CRNG		1		
18	R33	RES, METF, 1/8W, 1%, 301K	RN55D	CRNG		1		
19	R28,31,37	RES, CARBON 1/2W, 5%, 1M		STKPOL		3		
20	R68	RES, CARBON 1/2W, 10%, 6.8M				1		
21	R56, 57, 58	RES, METF, MATCHED SET(3) 4.99K		CRNG		3		
22								
23	R55	POTENTIOMETER 500Ω	91AR500	BCKMN		1		
24	R10	POTENTIOMETER 1K	91AR1K	BCKMN		1		
25	R32,35,66	POTENTIOMETER 100K	91AR100K	BCKMN		3		
26								
27								
28	C6,C9-C13, C15, C18,20,21,23, C29,30,32,35	CAP, CER DISC .01μF	CK103	CRL		15		
29	C34	CAP, CER DISC .1μF	CK104	CRL		1		
30	C26,28	CAP, CER DISC 5pf	DD050	CRL		2		
31	C33	CAP, CER DISC 10pf	DD150	CRL		1		

WAVETEK®
PARTS LIST

TITLE VCG BOARD

MODEL 152

DRAWN BY Adkins

APPROVAL

NO. A152-030

SH 2 OF 4

REV A

rm 102

ITEM NO.	REF DESIG	DESCRIPTION	MFGR PART NO.	MFGR	WAVETEK PART/STOCK NO.	QTY	STATION NO.	PREP NO.
12	C1,14,19,22, 25,27,31	CAP, CER DISC 33pf	DD330	CRL		7		
13	C42	CAP, SIL MICA 910pf	DM15-911F	CRL		1		
14	C2,4	CAP, ELECTRO 100/16V	16-375-100-15T	SPRG		2		
15	C5,7,8	CAP, TANT 33/10V	150D336X9010B2	SPRG		3		
16	C16,17,24	CAP, MYLAR 1µF/200V	210-B1C-105F			3		
17	C36,37	MATCHED SET 5µF	130-501-6	WVTK		2		
18	C38	MATCHED SET 1µF	130-501-6	WVTK		1		
19	C39	MATCHED SET .1µF	130-501-6	WVTK		1		
0	C40	MATCHED SET .01µF	130-501-6	WVTK		1		
1	C41	CAP, VARIABLE 15-60pf				1		
2								
3								
4	CR1-CR9	GENERAL PURPOSE	FD6666	FCHLD		9		
5								
6	K1-K5	RELAY	RA30191051	ELECTROL		5		
7								
8	Q1	TRANSISTOR, FET	NF510			1		
9	Q3,Q7-Q9	TRANSISTOR, NPN	2N3646	FCHLD		4		
0	Q2	TRANSISTOR, PNP	2N3905	FCHLD		1		
1	Q4,5,6	TRANSISTOR, PNP	2N5139	FCHLD		3		
2								
3								
4	IC11	IC, DISCRETE DIODES	CA3039	RCA		1		
5	IC8-IC10	IC, OP AMP	CA3080	RCA		3		
6	IC2,4,6,7,12	IC, OP AMP	LM301AN	RCA		5		
7	IC30	IC, QUAD 2-INPUT NOR GATE	N7402	SGNTCS		1		
8	IC26,28,29,25	IC, HEX INVERTER	N7404	SGNTCS		4		
9	IC32,33	IC, HEX INVERTER	N7405	SGNTCS		2		
0								
1	IC22	IC, 8-INPUT NAND GATE	N7430	SGNTCS		1		
2	IC23,27,31	IC, QUAD 2-INPUT BUFFER	N7438	SGNTCS		3		
3	IC1,IC3,IC5	IC, 5010	5010			3		
4	IC24	IC, 8264	8264			1		
5	IC14-IC21	IC, QUAD D-TYPE EDGE TRIG. F-F	N74175	SGNTCS		8		
6	IC13	IC, TP1321	TP1321			1		
7	IC34,35	IC, PU-14	899-R-682G	FCHLD		2		
8		AMP PINS (M)	661182-2	AMP		6		

WAVETEK®
PARTS LIST

TITLE VCG BD

MODEL 152

DRAWN BY Adkins

APPROVAL

NO. A152-030

SH 3 OF 4

REV A

ITEM NO.	REF DESIG	DESCRIPTION	MFGR PART NO.	MFGR	WAVETEK PART/STOCK NO.	QTY	STATION NO.	PREP NO.
68								
69								
70		AMP PINS (M)				6		

WAVETEK®
PARTS LIST

TITLE VCG BOARD
MODEL 152

DRAWN BY Adkins
APPROVAL

NO. A152-030
SH 4 OF 4

REV A

m 102

www.manualsplus.com
1030073